Can faces prime a language?*

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*Acknowledgements

This study is supported by the Special Research Fund (BOF) of Ghent University, the Spanish Government (PSI2011-23033), the Catalan Government (GRNC) -2014SGR1210), and the European Research Council under the European Community's Seventh Framework (FP7/2007-2013 Cooperation grant agreement 613465-AThEME).

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Abstract

Bilinguals have two languages that are activated in parallel. During speech production, language selection must occur on the basis of some cue. The present study investigated whether the face of an interlocutor can serve as such a cue. Spanish-Catalan and Dutch-French bilinguals were first familiarised with certain faces and their corresponding language during simulated Skype conversations. Afterwards, they carried out a language production task, in which they generated words associated with the words produced by familiar and unfamiliar faces on screen. Participants produced words faster when they had to respond to familiar faces speaking the same language as previously in the Skype simulation, compared to the same face speaking the unexpected language. Furthermore, this language priming effect disappeared when it became clear that the interlocutor was actually a bilingual. This suggests that faces can prime a language, but their cueing effect disappears when it turns out that they are unreliable as language cue.

Keywords: bilingualism, lexical access, language cues, face priming

Introduction

A bilingual walks into a bar in Barcelona and starts up a conversation with a gentleman sitting at a table. Their conversation is interrupted by a phone call from the bilingual's Spanish-speaking mother. When putting down the phone, the bilingual wants to resume the conversation, but starts wondering which language he was speaking with the gentleman prior to the interruption. Was it Spanish or was it Catalan?

Bilinguals have two available languages and continuously need to select the appropriate one for the given context. They seem to do this quite effortlessly, even though their two languages are constantly activated in parallel during speech production (Costa, Caramazza, & Sebastián-Gallés, 2000; Van Hell & Dijkstra, 2002) and comprehension (Colomé, 2001; Dijkstra, Grainger, & van Heuven, 1999; Van Assche, Duyck, Hartsuiker, & Diependaele, 2009). For instance, Costa et al. (2000) asked Catalan-Spanish bilinguals to name pictures whose names were either cognates (i.e. words with the same meaning and similar orthography and phonology) or non-cognates in the two languages. They found that bilinguals displayed shorter naming latencies for cognates than for non-cognates, because of cross-lingual activation transfer. This cognate facilitation effect supports the notion that lexical access is language non-selective.

Because speech production requires language selection at some point during the production process, language non-selective access implies a control mechanism that activates the proper language. Several theories have been proposed to explain this mechanism (e.g. Costa, Miozzo & Caramazza, 1999; Dijkstra & van Heuven, 2002; Green, 1998; Poulisse & Bongaerts, 1994). For instance, Poulisse and Bongaerts' model assumes that first (L1) and second (L2) language words are stored in a single network, lemmas are tagged with a language label (cf. Green, 1986) and language selection is driven by language cues in the conceptual input. Strikingly, none of these models are clear about which sort of cue initiates language selection. It is assumed that, in everyday life, language selection is determined by bottom-up information provided by context, such as the language in which the bilingual is being addressed. In experimental conditions, language selection can be driven through other contextual cues, such as (the language of) prime words or sentences. Nevertheless, it seems that these linguistic cues are often not sufficient to regulate language activation.

Hermans, Bongaerts, de Bot, and Schreuder (1998) showed that Dutch-English bilinguals were unable to restrict language activation to the target language in a picture-word interference paradigm. Their participants had to name pictures in English, ignoring simultaneously spoken English words. When the English word distractors were phonologically similar to the Dutch picture names, naming latencies were significantly slower, suggesting Dutch language activation during English production. Colomé and Miozzo (2010) presented Spanish-Catalan bilinguals with pairs of partially overlapping coloured pictures and instructed them to name the green picture in Spanish and ignore the red picture, which had a name that was either a Catalan cognate or non-cognate. They determined that distractor pictures with cognate names interfered more with picture naming.

So, it seems that even when only a single language is relevant for production, lexical activation is not restricted to a single language. Therefore, a number of other studies proposed that visual cues, which are extrinsic to the stimuli that are processed, might be able to do so, such as the sociocultural identity of a face. When Chinese-English bilinguals were instructed to name pictures of objects, their responses were facilitated when the picture was preceded by an image of a face consistent with the target language (e.g. an Asian face for a Chinese response) (Li, Yang, Scherf, & Li, 2013). Such language priming of faces may also impede speech production. This was demonstrated when Chinese immigrants' fluency in English was reduced when speaking to a Chinese instead of a Caucasian face (Zhang, Morris, Cheng, & Yap, 2013).

In the domain of language comprehension, Molnar, Ibañez-Molina, and Carreiras (2015) recently showed that face-language associations facilitate word recognition. Proficient Basque-Spanish bilinguals were faster to comprehend words delivered in the language previously associated with the interlocutors' face. Furthermore, Hartsuiker and Declerck (2009) found that face familiarity also influences language production. They asked Dutch-English bilinguals to describe what was happening in a scene with pictures of famous native English-speaking or native Dutch-speaking people (e.g. "Jennifer Aniston and Elvis Presley move up"). They found that participants experienced more non-target language intrusions when the language of the famous person's face and name was inconsistent with the language they were instructed to employ. For instance, participants instructed to reply in Dutch would utter the English instead of the Dutch conjunction in a sentence like Jennifer Aniston *and* (not : "*en*") Elvis Presley gaan naar boven").

The present study investigated whether a familiar face can serve as a language cue and subsequently affect language selection and production. Previous studies demonstrated a relation between the cultural identity of face and language, but does this relation persist when there is no cultural cue? In other words, can the face of the gentleman in the bar help the bilingual in selecting the appropriate language if the face is a priori neutral towards the target language? If so, language selection should be facilitated in any linguistic task where the target language is congruent with the language linked to the familiar face, while overriding this link (i.e. having to speak in a language not associated with the face) may result in costly top-down interference.

In order to test this hypothesis, we applied a language production task among Spanish-Catalan (Experiment 1) and Dutch-French (Experiment 2) bilinguals who were primed by familiar faces. First, participants were familiarised with 12 previously unknown faces through simulated Skype interactions (six spoke one language, six the other one). In the subsequent test phase, participants were required to generate words semantically related to the stimuli produced by both familiar and unfamiliar faces. Familiar faces could utter words either in the same language as during the Skype interactions (congruent trials) or in the language that was used by the other half of the interlocutors (incongruent trials). The unfamiliar faces served as baseline. Congruent, incongruent, and baseline trials were mixed and could appear in either language. To avoid effects of language switching (Costa & Santesteban, 2004; Meuter & Allport, 1999), we also included filler trials produced by other unfamiliar faces to precede language switches. Thus, both congruent and incongruent trials were always non-switch trials.

If familiar faces can indeed serve as language cues, participants would be faster in responding to congruent trials as opposed to baseline and incongruent trials. To ensure there was enough time to generate language expectation, all faces started speaking two seconds after they appeared on screen.

Experiment 1

Method

Participants

Twenty-four Spanish-Catalan participants, all early bilinguals, were recruited from the University of Pompeu Fabra in Barcelona. All participants were naive to the purpose of the experiment. Instead, they were told that the study explored the interactions between people via social media, such as Skype. Participants completed a questionnaire about their language proficiency and usage. A 5-point Likert scale was employed to tap into four language skills (comprehending, speaking, reading, and writing), ranging from 1 (rather bad) to 5 (native speaker level) in both Spanish and Catalan. A composite score was created to measure first language (L1) and second language (L2) proficiency. All means are reported in Table 1.

Table 1. Demographic data for Experiment 1 and 2, with standard deviations between parentheses.

	Experiment 1	Experiment 2
N	24	30
Male/female ratio	10/14	9/21
Age	21.7 (3.3)	24.4 (6.0)
First language (L1)		
Age of acquisition	0.0 (0.0)	0.2 (0.8)
Proficiency	4.9 (0.3)	4.9 (0.3)
Second language (L2)		
Age of acquisition	0.0 (0.0)	5.6 (4.5)
Proficiency	4.8 (0.4)	3.8 (0.6)

Materials and procedure

All participants were tested individually and the entire experiment lasted about 1.5 hours per participant. Tasks were presented via E-Prime 2 on an IBM-compatible laptop computer with a 15-inch screen, running XP. A voice key recorded all response latencies.

Exposure phase. This phase consisted of simulated Skype conversations with 12 different interlocutors and four interaction scenes per interlocutor. All scenes were recorded beforehand and superimposed on a Skype chat frame. A movie frame contained the face and shoulders of the interlocutor centred on screen in front of a white background. There were no ethnic differences between the interlocutors' faces.

The interaction scenes were divided into two fragments. The first fragment of each interaction always contained the interlocutor's Skype name. The scenes were ordered by interaction; participants first went through all initial interactions scenes, then all second interactions were completed and so on. Two interaction lists were created, in which half of the interlocutors spoke Spanish and the other half Catalan. Although all interlocutors were recorded in both languages, participants only heard them speak one of the two languages. The interlocutors' language was counterbalanced across lists.

Participants were seated in front of the computer and presented with one of the interaction lists. Skype windows appeared on screen and participants were asked to engage in conversation by answering the interlocutors' questions. Participants were not aware that their responses did not matter for the rest of the experiment. They were allowed to employ any language during the interactions, but in most of the cases they employed the one of the interlocutor.

Test phase. The test phase was composed of a noun-verb association task, consisting of 72 Catalan nouns or their Spanish translation equivalent (Appendix A), each used in one of three conditions (congruent, incongruent, and baseline). Only nouns that could easily be related to a verb were chosen, while cognates and false friends were excluded. Mean log frequency per million words was matched for Catalan and Spanish target words ($M_{\text{Catalan}} = 1.15$, $M_{\text{Spanish}} = 1.14$; $p = .89$) using NIM, an online stimuli search engine for Spanish, Catalan, and English (Guasch, Boada, Ferré, & Sánchez-Casas, 2013).

A total of 12 randomisation lists was created with four types of stimuli. Each list included 24 nouns produced by the interlocutors from the exposure phase (i.e. familiar faces) in the same language (congruent trials) and 24 in the other language (incongruent trials). Additionally, there were 24 nouns produced by unfamiliar faces (baseline trials) and 16 filler nouns, which were added to introduce language switches. Each familiar face appeared four times; twice as a congruent and twice as an incongruent trial. The unfamiliar faces also appeared four times; twice in Catalan and twice in Spanish.

Faces appeared one by one, centred on screen in front of a white background. After 2000 ms, the face produced the stimulus in Catalan or Spanish. Participants were asked to respond to these stimuli as quickly as possible, producing the first verb they associated with and in the same language as the given stimulus. They were given up until 5000 ms to respond, then the programme automatically moved on to the next trial.

Post-test phase. A face-language association task served as a manipulation check. Participants were presented with the 12 familiar faces and had to indicate whether these spoke Catalan or Spanish during the Skype simulation. That way, we were able to determine whether the exposure phase was sufficient for the participants to memorise both the face and its language.

Results

Association task. Analyses were performed on reaction times (RTs) of correct responses. These included all verbs that could plausibly be associated with the stimulus, even when the response was unexpected. All RTs deviating more than 2.5 SD from an individual’s mean were excluded from further analyses. This procedure eliminated 0.02% of all data. Omissions (0.04% of all data) and errors (e.g. responding in the incorrect language; 0.01% of all data) were not included in the analysis.

We performed a within-subject ($F1$) 2 (Language: Spanish, Catalan) x 3 (Condition: baseline, congruent, incongruent) ANOVA on mean RTs, and a between-item ($F2$) 2 (Language: Spanish, Catalan) x 3 (Condition: baseline, congruent, incongruent) ANOVA with Condition as between-factor. This yielded a main effect of Language ($F1_{1,23} = 16.71$, $p < .001$, $\eta p^2 = .421$; $F2_{1,69} = 12.70$, $p = .001$, $\eta p^2 = .155$) and Condition ($F1_{2,23} = 75.76$, $p < .001$, $\eta p^2 = .767$; $F2_{2,69} = 3.62$, $p = .032$, $\eta p^2 = .095$). Participants responded faster in Spanish than in Catalan. There was no Language X Condition interaction ($F1 < 1.00$, *ns*; $F2 = 1.36$, *ns*). Planned comparisons revealed slower responses to baseline trials ($M = 1885$, $SD = 283$) than to congruent ($M = 1578$, $SD = 271$) and incongruent ($M = 1575$, $SD = 258$) trials (respectively $t1_{23} = 10.42$, $p < .001$; $t2_{46} = 2.93$, $p = .005$ and $t1_{23} = 9.93$, $p < .001$; $t2_{47} = 1.75$, $p = .087$). There was no difference between congruent and incongruent trials.

A follow-up analysis tested the hypothesis that any effect of congruency would dissipate over the course of the experiment, as familiar faces had to speak in an unexpected language at a given point in order to obtain incongruent trials, weakening their face-language association. Trial position was taken into account and the 42 trials were divided into the first six (Position 1) and the remainder (Position 2) of the congruent and incongruent trials. The cut-off between Position 1 and 2 was placed at the first six trials, in order to have sufficient data points in both languages and to make sure the participants had seen every speaker once (either in the congruent or incongruent condition). The $F1$ was a 2 (Language) x 2 (Condition: congruent, incongruent) x 2 (Position) ANOVA, $F2$ had Condition and Position as between-factors. These analyses produced main effects of Language ($F1_{1,19} = 18.53$, $p < .001$, $\eta p^2 = .446$; $F2_{1,44} = 12.74$, $p = .001$, $\eta p^2 = .225$), but not of Condition ($F1_{1,19} = 3.05$, $p = .094$, $\eta p^2 = .117$; $F2_{1,44} < 1.0$, *ns*) or Position ($F1_{1,19} = 1.05$, $p = .316$, $\eta p^2 = .044$; $F2_{1,44} < 1.0$, *ns*). Crucially, the Condition X Position interaction was significant in the $F1$ analysis ($F1_{1,19} = 6.71$, $p = .016$, $\eta p^2 = .226$), but not in the $F2$ ($F2_{1,44} < 1.0$, *ns*), probably due to the limited number of observations and to the fact that both variables were between-item. Other interactions were not significant (all Fs < 1.0). Paired Samples *t*-tests revealed a difference between congruent and incongruent trials at Position 1 in the $F1$ analysis ($t1_{23} = -2.38$, $p = .026$; $t2_{22} = -0.85$, $p = .403$), with faster RTs on congruent trials. There was no congruency effect at Position 2 ($t1_{23} = 1.65$, $p = .113$; $t2_{23} = -0.43$, $p = .670$) (Figure 1).

Face-language association. The mean of correct face-language associations was 85.5% (Catalan: 83.3%, *SD* = 15.1%; Spanish: 87.7, *SD* = 12.5). No significant effects of Language appeared in remembering the language associated with a face.

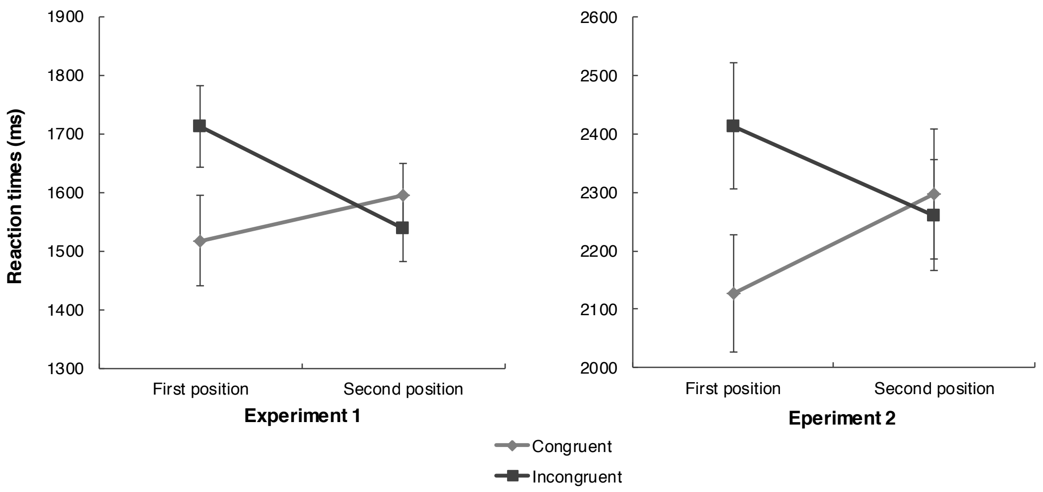

Fig. 1. RTs (ms) for congruent and incongruent trials by position. RTs in Experiment 1 for the first half and the remainder of congruent and incongruent trials (left). RTs in Block 2 of Experiment 2 for the first half and second half congruent and incongruent trials (right). Vertical bars represent standard error.

Discussion

Across the entire experiment, the noun-verb association yielded no effect of congruency: congruent trials were faster than baseline trials but comparable to incongruent trials. However, when looking only at the first six trials of the task, participants clearly responded much faster to congruent trials than to incongruent trials. These results suggest that faces can serve as a cue for a specific language. Moreover, the face-language association task confirmed that participants actually related an interlocutor's face to a certain language. Most interestingly, we also observed that the introduction of incongruent trials, which made the face less predictive for language in subsequent trials, strongly affected the congruency effect, so that there was no difference between congruent and incongruent trials later in the experiment. This demonstrates that while faces can prime a language, their effect rapidly vanishes when it turns out they are unreliable as language cue (i.e. when it becomes clear that the face at hand speaks more than one language.

All in all, the results of Experiment 1 demonstrate a priming effect of face, albeit only on the first trials. Because participants already experienced early on in the test phase that the familiar faces actually spoke two languages, we modified our design in Experiment 2, in order to have a higher number of congruent and baseline trials before introducing incongruent trials. This was conducted among Dutch-French bilinguals and the association task comprised two blocks. Block 1 contained only baseline and congruent trials, while Block 2 consisted of both congruent and incongruent trials. Additionally, a noun-noun instead of a noun-verb association was employed, because of the availability of a normed database to control for association frequency in both French and Dutch.

Our hypothesis remained that familiar faces have the ability to prime language. We assumed that RTs for congruent trials in Block 1 would be faster than the RTs on incongruent trials in Block 2. Furthermore, we expected that the congruency effect would only persist in the beginning of Block 2 and then quickly disappear, analogous to the results in Experiment 1, as the incongruent trials again will soon weaken the participants' expectations.

Experiment 2

Method

Participants

We tested 30 highly proficient Dutch-French bilinguals recruited in Ghent and Brussels. All participants were naive to the purpose of the experiment. There were 7 bilinguals from birth, 8 early bilinguals (L2 acquired between 1 and 6), and 15 late bilinguals (L2 acquired after age 6). Five participants indicated French as L1, while the others indicated Dutch. Participants completed a questionnaire about their language proficiency and usage. Again, a 5-point Likert scale was used to tap into four language skills in both Dutch and French and a composite score was created (see Table 1).

Materials and procedure

The procedure was the same as in Experiment 1. Oral responses were recorded via Edirol R-1 and RTs were determined manually in Praat (Boersma & Weenink, 2013).

Exposure phase. Materials were the same as in Experiment 1, except that all interaction scenes contained Belgian interlocutors speaking Dutch and French.

Test phase. The test phase was composed of a noun-noun association task, consisting of 48 French and Dutch nouns (Appendix B), appearing in all conditions (baseline, congruent, and incongruent). Only nouns that could easily be related to another and with the highest association frequency were chosen. Association frequency (M_{Dutch} = .18, M_{French} = .18), calculated using the database of De Deyne and Storms (2008), and number of phonological syllables (M_{Dutch} = 1.35, M_{French} = 1.45) were matched between Dutch target words and their French translation equivalents. Mean log frequency per million was also matched for Dutch and French targets (M_{Dutch} = 1.78, M_{French} = 1.80), using the WordGen stimulus generation program (Duyck, Desmet, Verbeke, & Brysbaert, 2004) on the basis of the Dutch CELEX corpus (Baayen, Piepenbrock, & Van Rijn, 1993) and the French Lexique corpus (New, Pallier, Brysbaert, & Ferrand, 2004). Paired samples t-tests showed that Dutch target words and their French translation equivalents were similar with respect to all these variables (all p-values > .13).

Eight randomisation lists of 66 trials were created and each contained two blocks. Block 1 consisted of 12 baseline words, 9 filler words, and 12 congruent words; Block 2 of another 9 filler words, 12 congruent words, and 12 incongruent words.

Post-test phase. The face-language association task was the same as in Experiment 1.

Results

Association task. Analyses were performed on correct response RTs only and those deviating more than 2.5 SD from an individual's mean were excluded from further analyses. This procedure eliminated 2.9% of all data. Error rates were high and included omissions (2.4%), responses in the incorrect language (2.1%) and grammatical category errors (i.e. responses that were not nouns) (7.4%). Stimuli that led to misinterpretations due to homophony (e.g. the French word 'bouche' was often interpreted as the English name 'Bush') were also excluded (2.9% of the data).

Block 1 contained congruent (M = 2163, SD = 423) and baseline trials (M = 2188, SD = 375), while Block 2 consisted of congruent (M = 2234, SD = 512) and incongruent (M = 2349, SD = 498) trials. We performed both $F1$ analyses, in which Language and Condition were manipulated within-participant, and $F2$ analyses, in which both factors were manipulated between-items. Block 1 analyses with baseline and congruent trials did not yield any effects of Condition (both Fs < 1.0, *ns*). In order to assess the congruency effect across blocks, we ran a 2 (Language) x 2 (Condition) ANOVA, containing the Block 1 congruent trials and Block 2 incongruent trials as

Conditions. These analyses yielded effects of Language in $F1$, with slower responses in French ($F1_{1,29} = 6.83$, $p = .014$, $\eta p^2 = .191$; $F2_{1,42} = 2.26$, $p = .140$, $\eta p^2 = .051$), and Condition in $F1$ ($F1_{1,29} = 6.94$, $p = .013$, $\eta p^2 = .193$; $F2_{1,42} = 2.14$, $p = .151$, $\eta p^2 = .048$). Participants responded slower to incongruent trials (Block 2) than to congruent trials (Block 1). There were no interactions (both Fs < 1.0, *ns*).

A follow-up analysis tested our crucial hypothesis that the congruency effect vanished over the course of Block 2. The position of congruent and incongruent trials was taken into account. The 24 trials were divided into the first half (Position 1) and the second half (Position 2) of congruent trials. The same was done for incongruent trials. A 2 (Language) x 2 (Condition) x 2 (Position) was conducted, yielding a main effect in $F1$ of Condition ($F1_{1,25} = 4.68$, $p = .040$, $\eta p^2 = .158$; $F2_{1,18} = 3.15$, $p = .093$, $\eta p^2 = .149$) and Language ($F_{1,25} = 5.82$, $p = .024$, $\eta p^2 = .189$; $F2_{1,18} = 3.48$, $p = .079$, $\eta p^2 = .162$), but not of Position (all Fs < 1.0, *ns*). Critically, the crucial Condition X Position interaction was significant ($F1_{1,25} = 8.03$, $p = .009$, $\eta p^2 = .243$; $F2_{1,18} = 5.45$, $p = .031$, $\eta p^2 = .232$). No other interactions were significant (all Fs < 1.0). Paired-samples t-tests revealed significantly faster congruent trials than incongruent trials at Position 1 ($t1_{29} = -3.16$, $p = .004$; $t2_{23} = -4.54$, $p < .001$), but not at Position 2 ($t1_{29} = 0.44$, $p = .666$; $t2_{23} = 0.33$, $p = .743$) (Figure 1).

Face-language association. Due to a technical malfunction, responses of three participants were not recorded. We performed analyses on the responses of the remaining 27 participants. The mean of correct face-language associations was 92.9% (Dutch: 94.4%, *SD* = 8.0%; French: 91.4%, *SD* = 14.2), which again validates the face-language manipulation. There were no significant effects of Language.

Discussion

We obtained a significant interaction between condition and position in Experiment 2, and therefore replicated the early congruency effect found in Experiment 1. Participants reacted much faster to congruent trials than to incongruent trials, but this effect disappeared towards the end of Block 2, after a few incongruent trials. These outcomes confirm the hypothesis that faces can prime a language as long as they are associated only with one language. Hence, the results of Experiment 2 confirm that participants responded faster to familiar faces speaking the language with which they were initially associated.

General discussion

As a bilingual's two languages are constantly activated in parallel during speech production (e.g. Colomé & Miozzo, 2010; Costa et al., 2000; Van Hell & Dijkstra, 2002), language selection must occur on the basis of some trigger. The current study investigated whether familiar faces that are specifically associated with one language could constitute such a cue and consequently affect language selection. We therefore recruited Spanish-Catalan and Dutch-French bilinguals to carry out a language production task, in which they had to generate words associated with the words produced by the familiar and unfamiliar faces on screen. Prior to this task, participants were acquainted with the familiar faces by interacting with them in simulated Skype conversations. Each face was associated with only one specific language. The stimuli in the language production task consisted of congruent trials (familiar faces uttering words in the same language as during the Skype conversations), incongruent trials (familiar faces speaking in the other language), baseline trials (unfamiliar faces), and filler trials (unfamiliar faces) to precede language switches. If faces can serve as language cues, we predicted that bilinguals should be faster in responding to congruent trials as opposed to baseline and incongruent trials.

The first experiment was conducted among Spanish-Catalan bilinguals and provided evidence that a face could prime a language, as a congruency effect revealed faster production when participants responded to a face speaking the expected language. Nevertheless, after the first incongruent trials, participants seem to have realised that a previously reliably Spanish-speaking interlocutor could also speak Catalan, or vice versa. This removed the strong predictive value of the face for language and immediately affected the congruency effect. We therefore modified the design in the second experiment, carried out among Dutch-French bilinguals.

In this second experiment two blocks were created, with a first block containing only baseline and congruent trials and the second block containing both congruent and incongruent trials. An overall congruency effect with faster RTs for congruent trials was found when comparing congruent trials from the first block with incongruent trials from the second block. Importantly, we also looked at the second block, where congruent and incongruent trials were mixed. Again, a congruency effect was initially present, but then disappeared. This confirmed the hypothesis that language selection can be triggered by a face prime. Nevertheless, it also suggests that faces can serve as prime only for as long as they are associated with only one language. As soon as faces lose their predictive consistency, they are no longer used as a language cue.

In general, Spanish-Catalan bilinguals were faster and made fewer errors than Dutch-French bilinguals, perhaps due to different task requirements in association. Participants may have found it easier to generate a verb-noun than noun-noun association. This possibility is supported by the fact that many Dutch-French bilinguals made the grammatical error of producing a verb when a noun was requested. We also found that participants reacted faster in Spanish and Dutch, but type of language never interacted with the crucial effect of congruency or with the congruency by position interaction. Additionally, Dutch-French bilinguals reported lower L2 proficiency scores than Spanish-Catalan bilinguals. To ascertain that L2 proficiency or age of acquisition did not affect the results, we correlated the self-reported L2 data with the congruency effects in both experiments and found no relation (r ranged between -.20 and .15, all ps $> .19$).

Li et al. (2013) established that the sociocultural identity of a face primes bilingual language activation. The current study now adds that the association between a culturally neutral face and a language may have a similar effect. Our study also demonstrates that even little experience with an interlocutor is enough to form such associations. However, it also shows that little experience with counterexamples (i.e. when these faces start speaking another language) is enough to override such expectancy. The face then loses its strong predictive value for language. An interesting remaining question here is whether the faces with strong cultural identity of Li et al. or Zhang et al. would also lose their cueing effect so quickly after incongruent trials, or instead remain priming the language associated with the culture.

Our results also mirror the effects found by Molnar et al. (2015) in the perception domain. They found that bilinguals are faster to comprehend words spoken in the language previously associated with the interlocutors, but not when it was clear that these interlocutors spoke two languages. In Molnar et al., faces were also ethnically neutral; it is therefore an interesting question whether their priming effect in comprehension would also disappear if the face is not a reliable language cue, using faces with a clear association between culture and language.

Finally, we believe our findings have substantial theoretical implications for models of bilingual language production, because they suggest some top-down mechanism that may tune production into one of two available languages based on reliable non-linguistic cues. Hence, they can be unified with the theory set forth by Poulisse and Bongaerts (1994), which states that language selection is determined during conceptualisation. So, a face that is linked to a particular language could activate word representations tagged with that language label. When words in the irrelevant language reach a higher level of activation (such as in incongruent trials, when the face elicits the incorrect language), it will take time to activate representations in the other language and therefore lead to longer RTs. At the same time, our findings indicate that as soon as a cue loses its language-specific predictive value, such top-down language priming disappears.

Author contributions

C. D. Martin and C. Vanden Bulcke contributed to the study conception and its design. E. Woumans and C. Vanden Bulcke performed the literature search, subject recruitment, data collection, data analyses, and data interpretation. E. Van Assche cued all response files. W. Duyck, R. J. Hartsuiker, and A. Costa provided critical revisions of the experimental design and the analyses. E. Woumans drafted the manuscript and all other authors contributed to the revision of it.

Ethical considerations

All subjects were healthy adult bilinguals. Their participation was entirely voluntarily and informed consents were read and signed. Per experiment, we opened a number of participation slots per week. Data-collection was stopped (before any analyses took place) when the week ended (for Experiment 1, this was after two weeks; for Experiment two, this was after four weeks) and the total of participants was more than 20.

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Appendix A

Catalan	Spanish	English translation
aixeta	grifo	*tap*
ànec	pato	*duck*
armilla	chaleco	*vest*
arracada	pendiente	*earring*
banya	cuerno	*horn*
barret	sombrero	*hat*
boira	niebla	*fog*
bolquer	pañal	*nappy*
butxaca	bolsillo	*pocket*
cadira	silla	*chair*
caixa	caja	*bank*
calaix	cajón	*box*
cantonada	esquina	*corner*
catifa	alfombra	*carpet*
cendra	ceniza	*ash*
cendrer	perro	*dog*
cervell	cerebro	*brain*
cistella	cesta	*cart*
claveguera	cloaca	*sewer*
colze	codo	*elbow*
cor	corazon	*heart*
crossa	muleta	*crutch*
cuc	gusano	*worm*
dit	dedo	*finger*
dona	mujer	*woman*
emprempta	huella	*trace*
encenedor	mechero	*lighter*
escacs	ajedrez	*chess*
espatlla	hombro	*shoulder*
espelma	vela	*candle*
estovalles	mantel	*tablecloth*
estruç	avestruz	*ostrich*
ferro	hierro	*iron*
fetge	hígado	*liver*
finestra	ventana	*window*
floc	copo	*flock*
galta	mejilla	*cheek*
galteres	paperas	*mumps*
ganivet	cuchillo	*knife*
genoll	rodilla	*knee*
gos	cenicero	*ashtray*
got	vaso	*glass*
granota	rana	*frog*
guardiola	hucha	*money box*
guineu	zorro	*fox*
guix	tiza	*chalk*
ham	anzuelo	*hook*
llar de foc	chimenea	*fireplace*
llauna	lata	*tin*
llençol	sábana	*sheet*
matalàs	colchón	*mattress*
migdiada	siesta	*nap*
mirall	espejo	*mirror*
misto	cerilla	*lucifer*

mitja	media	*half*
ocell	pájaro	*bird*
pastanaga	zanahoria	*carrot*
pebrot	pimiento	*pepper*
penjador	percha	*perch*
pit	pecho	*breast*
roure	roble	*oak*
safata	bandeja	*tray*
suro	corcho	*cork*
tasca	tarea	*task*
taula	mesa	*table*
tauró	tiburón	*shark*
tempesta	tormenta	*storm*
teulada	tejado	*roof*
tisores	tijeras	*scissors*
ulleres	gafas	*glasses*
vaixell	barco	*ship*
veu	voz	*voice*

Appendix B

Dutch	French	English translation
aap	singe	*monkey*
appel	pomme	*apple*
baard	barbe	*beard*
beer	ours	*bear*
blad	feuille	*leaf, sheet*
bloem	fleur	*flower*
boek	livre	*book*
dorst	soif	*thirst*
eend	canard	*duck*
ei	oeuf	*egg*
fles	bouteille	*bottle*
gevaar	danger	*danger*
hond	chien	*dog*
hoofd	tête	*head*
ijs	glace	*ice*
jongen	garçon	*boy*
kaas	fromage	*cheese*
kers	cerise	*cherry*
keuken	cuisine	*kitchen*
knie	genou	*knee*
koning	roi	*king*
koorts	fièvre	*fever*
lepel	cuiller	*spoon*
maan	lune	*moon*
mantel	manteau	*coat*
melk	lait	*milk*
mond	bouche	*mouth*
oog	oeil	*eye*
oorlog	guerre	*war*
peper	poivre	*pepper*
regen	pluie	*rain*
rok	jupe	*skirt*
schaap	mouton	*sheep*
schoen	chaussure	*shoe*
school	école	*school*
sleutel	clé	*key*
station	gare	*station*
stoel	chaise	*chair*
ui	oignon	*onion*
vader	père	*father*
verkeer	trafic	*traffic*
vis	poisson	*fish*
voet	pied	*foot*
vogel	oiseau	*bird*
wekker	réveil	*alarm*
zomer	été	*summer*
zon	soleil	*sun*
zus	soeur	*sister*